

## VERIFICATION OF TRANSLATION

I, Hirozumi Ono, being a citizen of Japan, residing at c/o ASAHINA & CO., NS Bldg., No. 2-22, Tanimachi 2-chome, Chuo-ku, Osaka-shi, Osaka, 540-0012, Japan, do solemnly and sincerely declare as follows:

I am a translator, of ASAHINA & CO. of NS Bldg., No. 2-22, Tanimachi 2-chome, Chuo-ku, Osaka, 540-0012, Japan.

I am well acquainted with the English and Japanese languages.

The attached translation is a true and correct translation into the English language of a certified copy of Japanese Patent Application No. 277995/1999 filed on September 30, 1999.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

This 26th day of December, 2003

by   
Hirozumi Ono

PATENT OFFICE  
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the  
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Patent Application Number: 277995/1999

Applicant: DAIKIN INDUSTRIES, LTD.

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[Title of the invention]	COMPOSITION FOR TRANSPARENT ELASTOMER MOLDED ARTICLE
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SPECIFICATION

[Title of the Invention]

COMPOSITION FOR TRANSPARENT ELASTOMER MOLDED  
ARTICLE

[CLAIMS]

1. A composition which comprises an elastomer and fluorine-containing resin fine particles finely dispersed in the elastomer and is used for obtaining a transparent elastomer molded article.

2. A composition which comprises an elastomer and fluorine-containing resin fine particles finely dispersed in the elastomer and further contains a filler; said composition is used for obtaining a transparent elastomer molded article.

3. The composition of Claim 1 or 2, wherein the elastomer is a fluorine-containing elastomer.

4. The composition of any of Claims 1 to 3, wherein the composition contains a crosslinking agent.

5. A process for preparing the composition of Claim 1 which comprises mixing an emulsion of elastomer particles and an emulsion of fluorine-containing resin fine particles and co-coagulating the mixture; said composition is used for obtaining a transparent elastomer molded

article.

6. The process of Claim 5, wherein the emulsion of fluorine-containing resin fine particles is an emulsion of fluorine-containing resin fine particles having an average particle size of from 20 to 150 nm.

7. A transparent elastomer molded article which is obtained by vulcanizing and molding the composition of any of Claims 1, 3 and 4.

8. The elastomer molded article which is obtained by vulcanizing and molding the composition of Claim 2.

#### [DETAILED EXPLANATION OF THE INVENTION]

##### [Technical Field of the Invention]

The present invention relates to a transparent elastomer composition comprising a transparent elastomer, for example, a fluorine-containing elastomer as a matrix and fine particles of fluorine-containing resin finely dispersed in the elastomer. The elastomer composition possesses enhanced mechanical strength and is useful as a base elastomer for various molded articles. Further the elastomer composition which is more excellent in mechanical strength can be provided by selecting an additive to be added thereto.

##### [Prior Art]

It has been known that a fluorine-containing resin is added to a fluorine-containing elastomer. An object of the addition is to enhance a mechanical strength by using the fluorine-containing resin as a clean filler and to utilize a friction property thereof. Also, for mixing

the resin and the elastomer, there are proposed a dry blend method by using a usual rubber mixing roll, a method for enhancing a dispersibility by using a solvent, and the like.

For example, in JP-A-55-151051, a fluorine-containing rubber excellent in abrasion resistance is obtained by blending a low molecular weight polytetrafluoroethylene (PTFE). Also, JP-A-63-178149 describes a method of adding and mixing a PTFE powder to a fluorine-containing rubber solution in order to enhance a gas barrier property and mechanical strength of a rubber. Further, JP-A-2-261850 proposes that a fluorine-containing resin is blended in a large amount of from 30 to 150 parts by weight together with an organic solvent to 100 parts by weight of a rubber to lower a friction coefficient and enhance mechanical properties.

Example of an addition of a fluorine-containing resin for obtaining cleanliness is WO97/08239 which discloses that a composition prepared by adding 5 to 50 parts by weight of a fluorine-containing resin powder having an average particle size of from 0.2 to 50  $\mu\text{m}$  to 100 parts by weight of a fluorine-containing rubber is excellent as a sealing agent for etching equipment. Also, WO95/02634 discloses that a composition prepared by adding 2 to 50 parts by weight of a fluorine-containing resin fine powder to 100 parts by weight of a rubber component is a clean composition suitable for a wet process of semiconductors.

However those prior techniques are directed to addition and mixing of a fluorine-containing resin to a matrix rubber (elastomer), and even if a dispersibility is enhanced by using a solvent, as a particle size becomes finer, a uniform dispersion is difficult to obtain. This is shown

by a fact that for example, when fine particles of a fluorine-containing resin are dispersed in a transparent elastomer, if they are dispersed uniformly, the composition should be transparent, but actually a transparent elastomer composition in which a fluorine-containing resin is finely uniformly dispersed has not yet been obtained.

If fine particles of a fluorine-containing resin are not dispersed uniformly, an effect of adding the fluorine-containing resin is not obtained sufficiently for a molded article obtained by vulcanizing and molding.

[Problem to be Solved by the Invention]

It is therefore an object of the present invention to provide an elastomer composition which is in a state that fluorine-containing resin fine particles are dispersed uniformly in a transparent elastomer, and can exhibit a maximum effect of adding the fluorine-containing resin.

[Means to Solve the Problem]

Namely, the present invention relates to a transparent elastomer composition in which fine particles of a fluorine-containing resin are finely dispersed in a transparent elastomer.

It is preferable that the transparent elastomer as a matrix is a fluorine-containing elastomer. Also it is preferable that the fine particles of a fluorine-containing resin have an average particle size of from 20 to 150 nm.

The present invention also relates to an elastomer composition containing a crosslinking agent and as the case demands, a crosslinking accelerator and a filler.

The elastomer composition of the present invention can be prepared, for example, by mixing an emulsion of transparent elastomer



particles and an emulsion of fluorine-containing resin fine particles and then co-coagulating the mixture.

The present invention also relates to a transparent elastomer molded article obtained by vulcanizing and molding the above-mentioned elastomer composition.

[Embodiment of the Invention]

In the present invention, uniform dispersion of fine particles of a fluorine-containing resin which has been difficult to obtain is achieved by the method of mixing an emulsion of transparent elastomer particles and an emulsion of fluorine-containing resin fine particles and then co-coagulating the mixture.

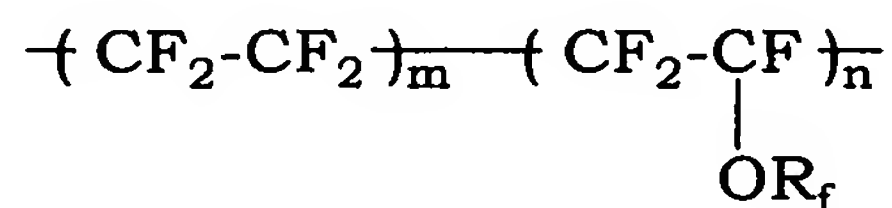
Whether or not the fluorine-containing resin fine particles are dispersed finely uniformly can be judged by determining whether or not transparency of the transparent matrix elastomer is maintained even after mixing of the fluorine-containing resin fine particles. In other words, the mixture obtained by dispersing is turbid in white even if the dispersing of the fluorine-containing resin fine particles having the same particle size is carried out by a dry blend method or by a method of mixing by using a solvent. It can be considered that this is because the fluorine-containing resin fine particles are subject to secondary agglomeration or are dispersed locally.

The matrix elastomer to be used in the present invention is good as far as it is a transparent elastomer capable of forming an emulsion in the form of particles and has affinity for the fluorine-containing resin. From this point of view, a fluorine-containing elastomer is preferable.

Examples of the fluorine-containing elastomer are, for

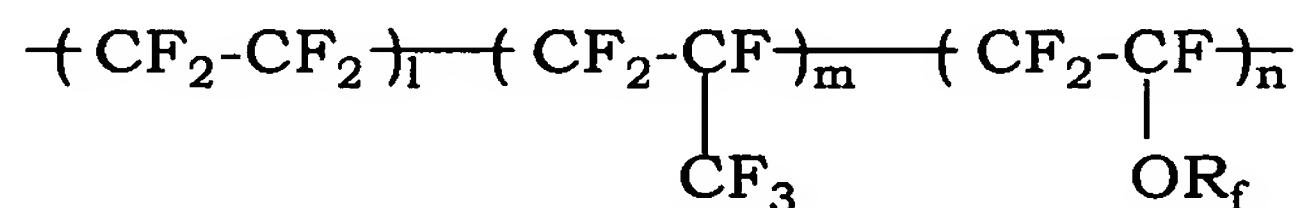
instance,

copolymer elastomers (tetrafluoroethylene (TFE)/perfluoro(alkyl vinyl ether) (PAVE) elastomers) represented by the formula (1):



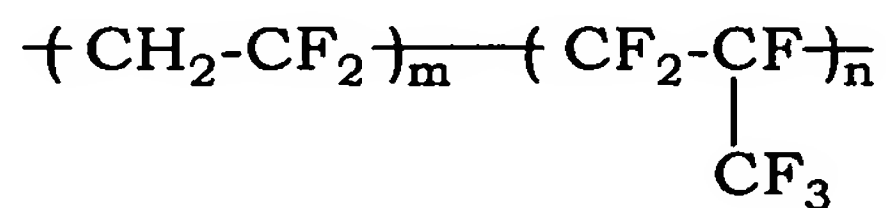
wherein m is from 95 to 50, n is from 5 to 50, R<sub>f</sub> is a perfluoroalkyl group having 1 to 8 carbon atoms,

terpolymer elastomers (TFE/PAVE elastomers) represented by the formula (2):



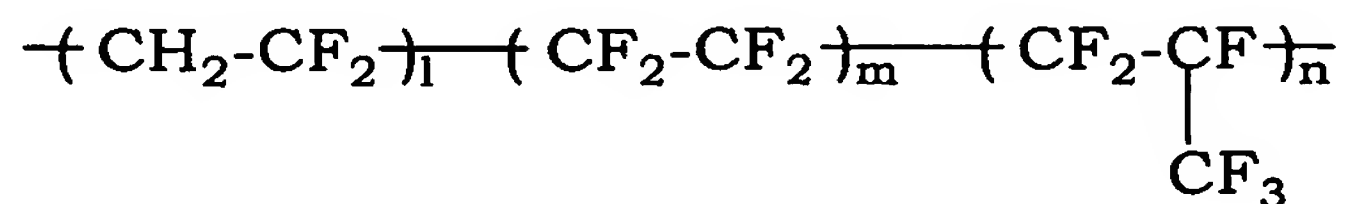
wherein l is from 95 to 35, m is from 0 to 30, n is from 5 to 35, R<sub>f</sub> is a perfluoroalkyl group having 1 to 8 carbon atoms,

copolymer elastomers represented by the formula (3):

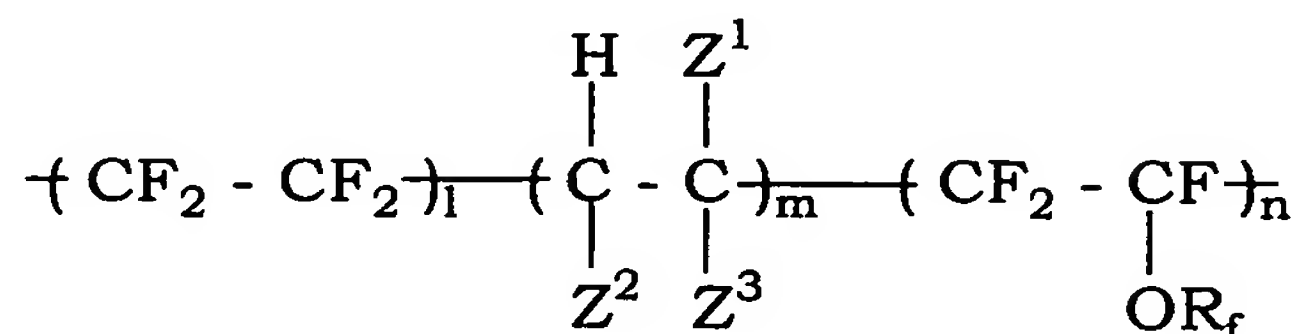


wherein m is from 85 to 60, m is from 15 to 40,

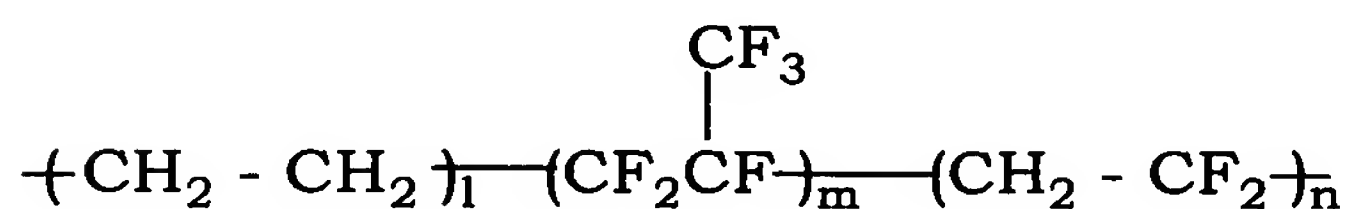
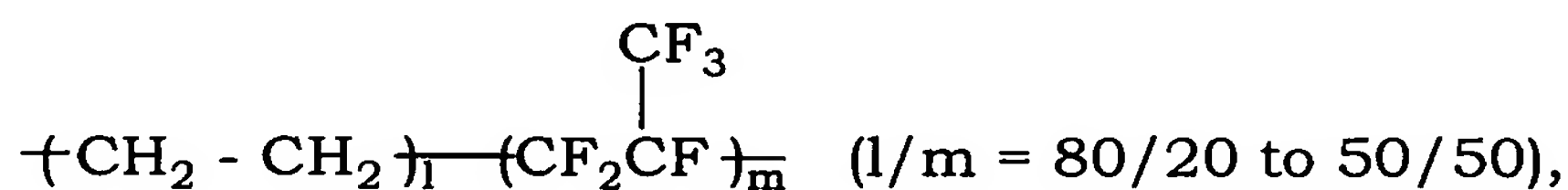
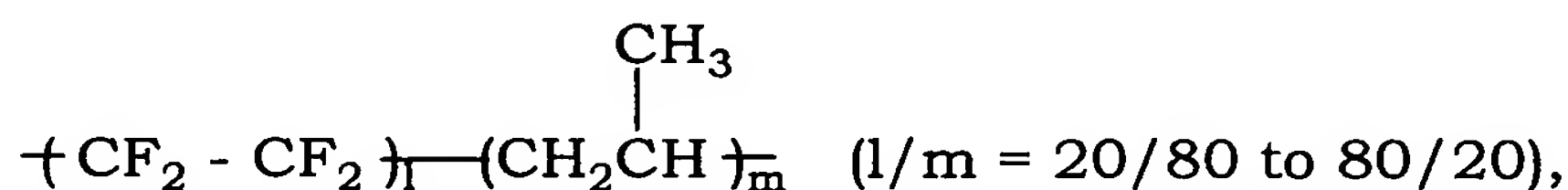
terpolymer elastomers represented by the formula (4):



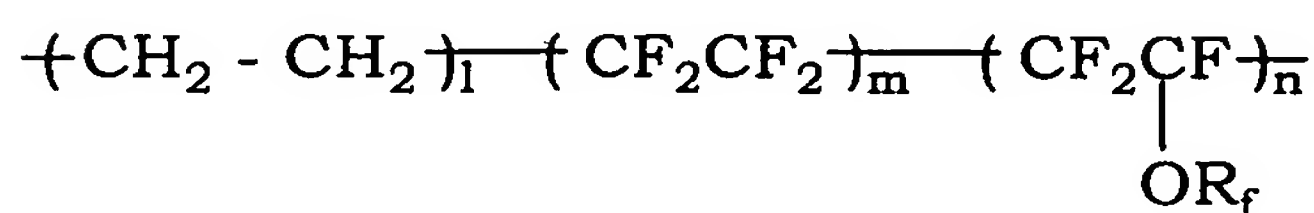
wherein l is from 85 to 20, m is from 0 to 40, n is from 15 to 40, terpolymer elastomers represented by the formula (5):



wherein l is from 95 to 45, m is from 0 to 10, n is from 5 to 45,  $Z^1$ ,  $Z^2$  and  $Z^3$  are fluorine atoms or hydrogen atoms independently,  $R_f$  is a perfluoroalkyl group having 1 to 8 carbon atoms,



(l/m/n = 10 to 65/15 to 45/0.1 to 45),



(l is from 1 to 80, m is from 0 to 80, n is from 10 to 50,  $R_f$  is as defined above),

and the like.

More concretely there are TFE/PAVE copolymer elastomer, vinylidene fluoride (VdF)/hexafluoropropylene (HFP) copolymer elastomer, VdF/HFP/TFE copolymer elastomer, VdF/TFE/PAVE copolymer elastomer, and the like. A small amount of monomer having a crosslinkable reaction group may be copolymerized with those elastomers. Examples of the crosslinkable reaction group are, for instance, iodine atom, bromine atom, nitrile group, carboxyl group, unsaturated double bond, hydroxyl group, and the like.

Those fluorine-containing elastomers can be prepared by usual emulsion polymerization method, and the obtained polymerization reaction product which is an emulsion can be used as it is for co-coagulation to be described hereinbelow, or can be used for the co-coagulation after optionally adjusting a concentration thereof. The emulsion may be once dried and then formed into an emulsified dispersion again.

Examples of the elastomer other than the fluorine-containing elastomer are, for instance, hydrogenated nitrile butadiene rubber, acrylic rubber, silicone rubber, and the like.

An average particle size of the elastomer particles in the emulsion is not limited particularly, and is, for example, from 10 to 800 nm, preferably from 20 to 500 nm. However when the average particle size is less than 10 nm, the coagulation becomes difficult, and when the average particle size is more than 800 nm, the emulsion becomes unstable and the co-coagulation becomes difficult.

The fine particles of the fluorine-containing resin to be finely dispersed into the elastomer are not limited particularly. For example,

there are fine particles of:

- (1) polytetrafluoroethylene (PTFE);
- (2) TFE/ $\text{CF}_2=\text{CF}-\text{O}-\text{R}_f^1$  (FVE) copolymer (Proportion thereof is one exhibiting a non-elastomeric property, for example, a proportion of  $\text{CF}_2=\text{CF}-\text{O}-\text{R}_f^1$  is not more than 15 % by mole.  $\text{R}_f^1$  is a linear or branched fluoro- or perfluoroalkyl group or a fluoro- or perfluorooxyalkyl group which may have at least one ether type oxygen atom.). For example, TFE/PAVE copolymer (PFA);
- (3) TFE/ $\text{CF}_2=\text{CF}-\text{R}_f^1$  copolymer (Proportion thereof is one exhibiting a non-elastomeric property, for example, a proportion of  $\text{CF}_2=\text{CF}-\text{R}_f^1$  is not more than 15 % by mole.  $\text{R}_f^1$  is as defined above.) For example, TFE/HFP copolymer (FEP);
- (4) Ethylene/TFE (30 to 60/70 to 40 in % by mole, hereinafter the same) copolymer;
- (5) Polychlorotrifluoroethylene (PCTFE);
- (6) Ethylene/chlorotrifluoroethylene (CTFE) (30 to 60/70 to 40) copolymer;
- (7) Polyvinylidene fluoride (PVdF);
- (8) Vinylidene fluoride (VdF)/TFE (70 to 99/30 to 1) copolymer;
- (9) VdF/TFE/CTFE (50 to 99/30 to 0/20 to 1) copolymer;
- (10) VdF/TFE/hexafluoropropylene (HFP) (60 to 99/30 to 0/10 to 1) copolymer;
- (11) Ethylene/TFE/HFP (6 to 60/40 to 81/1 to 30) copolymer;
- (12) 3,3,3-trifluoropropylene-1,2-trifluoromethyl-3,3,3-trifluoropropylene-1/PAVE (40 to 60/60 to 40) copolymer;

and the like. Among them, when a friction property is imparted to the molded article, the above-mentioned (1) is preferred. Particularly in

order to enhance compatibility with the perfluoroelastomer component, the above-mentioned (2) and (3) are preferred.

The PTFE of the above-mentioned (1) encompasses not only TFE homopolymer but also a modified PTFE obtained by copolymerizing a comonomer in such a small amount as not giving melt-flowability. Examples of the comonomer are HFP, CTFE, perfluorovinylether, trifluoroethylene, perfluoroalkylethylene, and the like. When perfluorovinylether is copolymerized as a comonomer, its amount is up to 2 % by weight, preferably from 0.001 to 1 % by weight, more preferably from 0.01 to 1 % by weight.

Those fluorine-containing resins can be prepared by usual emulsion polymerization method, and the obtained polymerization reaction product which is an emulsion can be used as it is for coagulation to be described hereinbelow or can be used for the coagulation after optionally adjusting a concentration thereof. The emulsion may be once dried and then formed into an emulsified dispersion again.

An average particle size of the fluorine-containing resin fine particles in the emulsion is less than 200 nm, preferably from 20 to 150 nm, more preferably from 20 to 100 nm. When the average particle size is too small, productivity is lowered remarkably, and when the average particle size is not less than 200 nm, a uniform dispersion cannot be obtained.

The mixing ratio of the elastomer and the fluorine-containing resin may be selected optionally depending on properties to be imparted to the molded article. It is desirable that the amount of the fluorine-containing resin is not less than 1 part by weight, preferably not less

than 5 parts by weight based on 100 parts by weight of the elastomer from the point of obtaining a reinforcing effect, and is not more than 150 parts by weight, preferably not more than 100 parts by weight based on 100 parts by weight of the elastomer from the point of easiness in processing of the obtained crosslinked rubber.

The combination of the elastomer with the fluorine-containing resin may be selected to intended functions in consideration of whether or not coagulating property thereof is approximate to each other and whether or not they have affinity as a polymer.

Non-restricted examples of the preferable combination are, for instance,

- (a) TFE/PAVE elastomer with TFE/PAVE resin (PFA);
  - (b) TFE/PAVE elastomer with TFE/HFP resin (FEP);
  - (c) VdF/HFP elastomer with PVdF resin;
  - (d) VdF/HFP/TFE elastomer with PVdF resin;
  - (e) TFE/propylene elastomer with ethylene/TFE resin (ETFE);
- and the like.

The elastomer composition of the present invention can be prepared by mixing the above-mentioned emulsion of the elastomer particles to the emulsion of the fluorine-containing resin fine particles and then co-coagulating the mixture. The co-coagulation can be carried out by known co-coagulation method. For example, there can be used a method of adding a solution of the mixture of the emulsion of the elastomer particles and the emulsion of the fluorine-containing resin fine particles dropwise into a coagulating solution, a method of adding a coagulating solution dropwise into a solution of the emulsion mixture, or the like method.



The concentration of the emulsion mixture may be determined optionally depending on productivity and is not limited particularly. The concentration is usually from 5 to 50 % by weight, preferably from 10 to 25 % by weight.

Concretely there are co-coagulation methods, for instance, a salting out method, an acid coagulation method, a freeze coagulation method, a method of applying a mechanical shearing force, and the like.

As a coagulating agent, there can be used, for example, an acid such as a nitric acid, hydrochloric acid or sulfuric acid; a metal salt such as aluminum nitrate or aluminum sulfate; or the like. Among them, the acid is preferred from the viewpoint of keeping the polymer clean, and the metal salt is preferred from the viewpoint of easiness of handling.

A product obtained by the co-coagulation is washed as the case demands, and dried in a hot air dryer or a vacuum dryer, and thus can be used as a base material for molding.

When the elastomer composition of the present invention is used as a base material, excellent mechanical strength, abrasion resistance, transparency and mold-processability can be imparted to the obtained molded article.

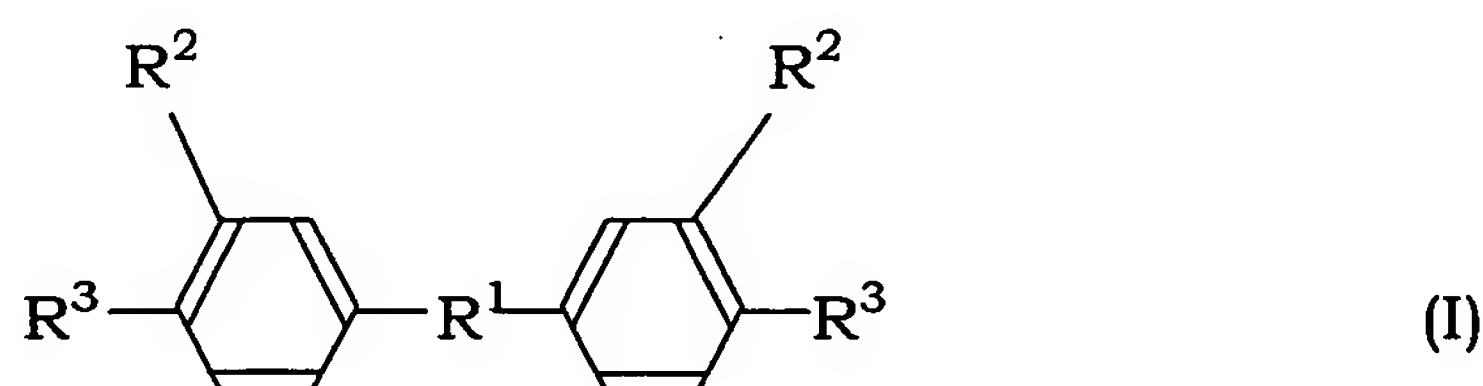
To the elastomer composition of the present invention can be added a crosslinking agent and further a crosslinking accelerator and thus a crosslinkable elastomer composition can be obtained.

As a crosslinking system, those which have been usually used for an elastomer can be used. Examples thereof are, for instance, an oxazole crosslinking system, imidazole crosslinking system, thiazole crosslinking system, triazine crosslinking system, peroxide crosslinking

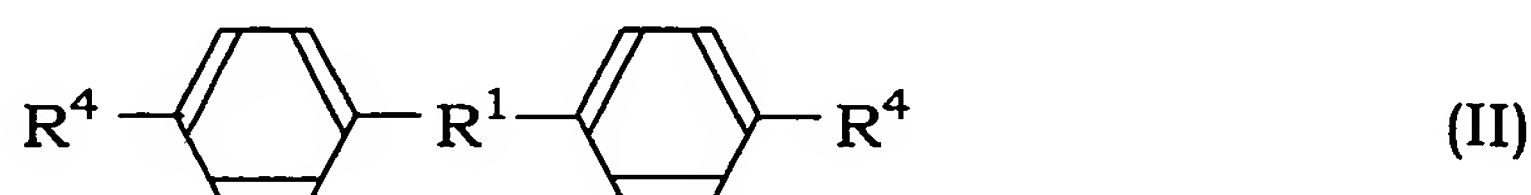


system, polyol crosslinking system, polyamine crosslinking system, and the like. Also crosslinking with radiant ray, electron beam, ultraviolet ray, or the like can be carried out.

Examples of the crosslinking agent which is used in oxazole crosslinking system, imidazole crosslinking system and thiazole crosslinking system are, for instance, a tetraamine crosslinking agent or bisamino(thio)phenol crosslinking agent represented by the formula (I):



wherein  $\text{R}^1$  is  $-\text{SO}_2-$ ,  $-\text{O}-$ ,  $-\text{CO}-$ , an alkylene group having 1 to 6 carbon atoms, a perfluoroalkylene group having 1 to 10 carbon atoms or a single bond, one of  $\text{R}^2$  and  $\text{R}^3$  is  $-\text{NH}_2$  and another one is  $-\text{NH}_2$ ,  $-\text{OH}$  or  $-\text{SH}$ , a bisamidrazone crosslinking agent represented by the formula (II):

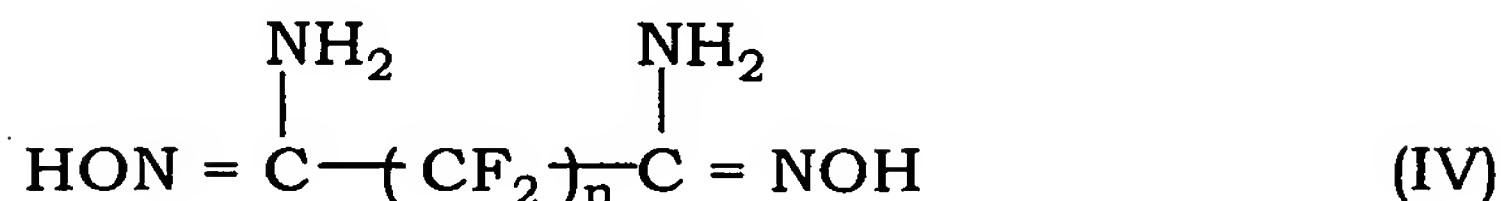


(wherein  $\text{R}^1$  is as defined above,  $\text{R}^4$  is  $-\text{C} \begin{array}{l} \text{=NH} \\ \text{NHNH}_3 \end{array}$  or  $-\text{C} \begin{array}{l} \text{=NOH} \\ \text{NH}_2 \end{array}$ ),

a bisamidoxime crosslinking agent represented by the formula (III) or (IV):



wherein  $R_f^2$  is a perfluoroalkylene group having 1 to 10 carbon atoms,



wherein n is an integer of from 1 to 10, and the like.

As the case demands, a crosslinking accelerator may be used together.

An amount of the crosslinking agent is from 0.5 to 10 parts by weight, preferably from 1 to 5 parts by weight based on 100 parts by weight of the elastomer, and an amount of the crosslinking accelerator is from 0.1 to 10 parts by weight, preferably from 0.2 to 5 parts by weight based on 100 parts by weight of the elastomer.

Examples of the crosslinking agent to be used in the peroxide crosslinking system are, for instance, 1,1-bis(t-butylperoxy)-3,5,5-trimethylcyclohexane, 2,5-dimethylhexane-2,5-dihydroperoxide, di-t-butylperoxide, t-butylcumylperoxide, dicumylperoxide,  $\alpha,\alpha$ -bis(t-butylperoxy)-p-diisopropylbenzene, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, 2,5-dimethyl-2,5-di(t-butylperoxy)-hexyne-3, benzoylperoxide, t-butylperoxybenzene, 2,5-dimethyl-2,5-di(benzoylperoxy)hexane, t-butylperoxymaleate, t-butylperoxyisopropyl carbonate, and the like.

In case of the peroxide crosslinking, it is desirable to use a crosslinking accelerator. Examples of the crosslinking accelerator are, for instance, triallyl cyanurate, triallyl isocyanurate, triallyl formal, triallyl trimellitate, N,N'-m-phenylenebismaleimide, dipropargyl terephthalate, diallyl phthalate, tetraallyl terephthalateamide, triallyl phosphate, and the like.

An amount of the crosslinking agent is from 0.05 to 10 parts by weight, preferably from 1.0 to 5 parts by weight based on 100 parts by weight of the elastomer, and an amount of the crosslinking accelerator is from 0.1 to 10 parts by weight, preferably from 0.5 to 5 parts by weight based on 100 parts by weight of the elastomer.

Examples of the crosslinking agent which can be used in the polyol crosslinking system are aromatic polyhydroxy compounds to be usually used. For example, there are 2,2-bis(4-hydroxyphenyl)propane (so-called bisphenol A), 2,2-bis(4-hydroxyphenyl)perfluoropropane (so-called bisphenol AF), resorcin, 1,3,5-trihydroxybenzene, 1,7-dihydroxynaphthalene, 2,7-dihydroxynaphthalene, 1,6-dihydroxynaphthalene, 4,4'-dihydroxydiphenyl, 4,4'-dihydroxystilbene, 2,6-dihydroxyanthracene, hydroquinone, catechol, 2,2-bis(4-hydroxyphenyl)butane (so-called "bisphenol B"), 4,4-bis(4-hydroxyphenyl)valerate, 2,2-bis(4-hydroxyphenyl)tetrafluorochloropropane, 4,4'-dihydroxydiphenylsulfone, 4,4'-dihydroxydiphenylketone, tri(4-hydroxyphenyl)methane, 3,3',5,5'-tetrachlorobisphenol A, 3,3',5,5'-tetrabromobisphenol A, alkali metal salt or alkali earth metal salt thereof, and the like.

Also in the polyol crosslinking system, it is preferable to use a crosslinking accelerator together. Examples thereof are, for instance, ammonium compounds, phosphonium compounds, oxonium compounds, sulfonium compounds, and the like. Particularly, quaternary ammonium salt and quaternary phosphonium salt are preferable.

An amount of the crosslinking agent is from 0.5 to 5 parts by

weight based on 100 parts by weight of the elastomer, and an amount of the crosslinking accelerator is from 5 to 400 parts by weight, preferably from 10 to 100 parts by weight based on 100 parts by weight of the crosslinking agent.

As a crosslinking agent to be used for the polyamine crosslinking system, there are polyamine compounds. Examples of the polyamine compound are a primary amine or secondary amine in which two or more basic nitrogen atoms are bonded in a molecule thereof. In many cases, those amines are modified to be formed into a salt so that a reaction becomes mild. Examples thereof are, for instance, alkylenediamines such as ethylenediamine carbamate, hexamethylenediamine carbamate and 4,4'-diaminocyclohexylmethane carbamate which are used comparatively well. Also, there can be used Schiff salts such as N,N'-dicinnamylidene-1,6-hexamethylenediamine. In addition the aromatic polyamine compounds having poor basic property can be used preferably in combination with other basic compounds. Examples of the other basic compound are, for instance, diphenylguanidine, di-o-triguanidine, diphenylthiourea, 2-mercaptoimidazoline, and in addition, a compound which has -NH<sub>2</sub> and/or -NH- in its molecule and is used as a crosslinking accelerator for a synthetic rubber, a divalent metal hydroxide, and the like.

An adding amount of the crosslinking agent is from 0.1 to 10 parts by weight, preferably from 0.5 to 5 parts by weight based on 100 parts by weight of the elastomer.

Examples of the other additives are a filler (excluding the above-mentioned fluorine-containing resin), a pigment, and the like.

Examples of the filler are, for instance, inorganic fillers such

as carbon black (particularly graphitized carbon black), silicon oxide, titanium oxide and alumina; organic fillers such as polyimide, and the like. An adding amount thereof is not more than 100 parts by weight, preferably from 1 to 50 parts by weight based on 100 parts by weight of the elastomer.

The above-mentioned additives such as a crosslinking agent, crosslinking accelerator and filler may be added at the time of the above-mentioned co-coagulation if possible, or may be mixed after the preparation of the composition comprising the elastomer and the fluorine-containing resin fine particles. The mixing method may be a known kneading method by using a roll, or the like method.

A crosslinked molded article can be produced by kneading and crosslinking the thus obtained crosslinkable elastomer composition in which fluorine-containing resin fine particles are finely dispersed. For the kneading, usual methods, for example, kneading by a roll or kneader can be employed. For the molding, usual compression molding, injection molding, extrusion molding and transfer molding methods can be employed. The molding conditions may be the same as conventional ones.

The obtained crosslinked molded article maintains transparency of the matrix elastomer when a filler is not contained therein. Though there is a case that the transparency is lowered somewhat, a transmissivity of visible light is maintained at 20 % or more of that in case of sole use of the elastomer.

The crosslinked molded article of the present invention is excellent in mechanical strength, post-processability, plasma resistance and gas barrier property irrespective of presence or absence of the filler.

Also, since the fluorine-containing resin fine particles finely dispersed are hardly separated from the matrix elastomer, for example, even if the molded article is used as a sealing material for semiconductor production apparatuses, there is less possibility of generating micro-particles.

The elastomer composition of the present invention is suitably used for molded articles shown in Tables 1 to 3 by making the use of its excellent properties.

TABLE 1

Field of industry	Sub-field of industry	Final product	Equipment
Electrical	Semi-conductor	Semi-conductor production apparatus	CVD equipment
		Liquid crystal panel production apparatus	Dry etching equipment
		Plasma panel production apparatus	Wet etching equipment
			Oxidation and diffusion equipment
			Sputtering equipment
Transportation	Vehicle		Ashing equipment
			Cleaning equipment
			Ion implantation equipment
			Engine and peripheral equipment
			AT
			Fuel line and peripheral equipment
		Aircraft	Fuel line
		Rocket	Fuel line
		Ship	Fuel line

- continued -

- continued -	Parts
O (square) ring, packing, sealing material, tube, roll, coating, lining, gasket, diaphragm, hose	
Gasket, shaft seal, valve stem seal, sealing material, hose	
Hose, sealing material	
O (square) ring, tube, packing, core material of valve, hose, sealing material, diaphragm	
Diaphragm, O (square) ring, valve, tube, packing, hose, sealing material	
ditto	
ditto	
	- continued -



- continued -

Chemical	Chemical products	Plant	Production line of chemicals such as pharmaceutical, agricultural chemical, coating and resin
			(Petroleum)
	Chemicals	Pharmaceuticals	Plug for chemicals
Mechanical	Photograph	Developing machine	Film developing machine
			X-ray film developing machine
	Printing	Printing machine	Printing roll
	Coating	Coating facilities	Coating roll
	Analyzer and physical and chemical appliances		
Food	Plant		Food processing line
Metal	Steel making	Steel sheet processing facilities	Steel sheet processing roll
	- continued -		

- continued -
Lining, valve, packing, roll, hose, diaphragm, O (square) ring, tube, sealing material
Plug for chemicals
Roll
Roll
Roll
Roll
Tube
Lining, valve, packing, roll, hose, diaphragm, O (square) ring, tube, sealing material
Roll

TABLE 2

Field of Industry	Characteristics Required
Electrical	Plasma resistance, acid resistance, alkali resistance, amine resistance, ozone resistance, gas resistance, chemical resistance, cleanliness, heat resistance
Transportation	Heat resistance, amine resistance
	Heat resistance, amine resistance
	Fuel resistance, fuel permeability, heat resistance
	Fuel resistance, fuel permeability, heat resistance
	Fuel resistance, fuel permeability, heat resistance
	Fuel resistance, fuel permeability, heat resistance

- continued -

- continued -	
Chemical	Chemical resistance, solvent resistance, heat resistance
	Chemical resistance, solvent resistance, heat resistance
	Cleanliness
Mechanical	Chemical resistance
	Chemical resistance
	Solvent resistance
	Solvent resistance
Food	Chemical resistance, solvent resistance, heat resistance
Metal	Heat resistance, acid resistance

TABLE 3

Field of industry	Parts
Electrical	O ring and sealing material for gate valve of corresponding production equipment
	O ring and sealing material for quartz window of corresponding production equipment
	O ring and sealing material for chamber of corresponding production equipment
	O ring and sealing material for gate of corresponding production equipment
	O ring and sealing material for bell jar of corresponding production equipment
	O ring and sealing material for coupling of corresponding production equipment
	O ring and sealing material for pump of corresponding production equipment
	O ring and sealing material for gas controller for semi-conductor of corresponding production equipment
	O ring and sealing material for resist developing and releasing solutions
	O ring and sealing material for wafer cleaning solution
	Diaphragm of pump for corresponding production equipment
	Hose for resist developing and releasing solutions
	Hose and tube for wafer cleaning solution
	Roll for transferring wafer

Lining and coating of tanks for resist developing and releasing solutions
Lining and coating of tanks for wafer cleaning solution
Lining and coating of tanks for wet etching

- continued -

- continued -

Transportation	Engine head gasket
	Metal gasket
	Crank shaft seal
	Cam shaft seal
	Valve stem seal
	Manifold packing
	Oil hose
	ATF hose
	Injector O ring
	Injector packing
	O ring and diaphragm for fuel pump
	Fuel hose

- continued -

- continued -

Chemical

Mechanical

Developing roll

Developing roll

Gravure roll

Guide roll

Gravure roll for magnetic tape production and coating line

Guide roll for magnetic tape production and coating line

Various coating rolls

Food

Metal

Particularly the molded articles of the present invention can be used built-in the following semiconductor manufacturing equipment.

(1) Etching system

Dry etching equipment

Plasma etching machine

Reactive ion etching machine

Reactive ion beam etching machine

Sputter etching machine

Ion beam etching machine

Wet etching equipment

Ashing equipment

(2) Cleaning system

Dry etching cleaning equipment

UV/O<sub>3</sub> cleaning machine

Ion beam cleaning machine

Laser beam cleaning machine

Plasma cleaning machine

Gas etching cleaning machine

Extractive cleaning equipment

Soxhlet extractive cleaning machine

High temperature high pressure extractive cleaning machine

Microwave extractive cleaning machine

Supercritical extractive cleaning machine

(3) Exposing system

Stepper

Coater and developer

(4) Polishing system



CMP equipment

(5) Film forming system

CVD equipment

Sputtering equipment

(6) Diffusion and ion implantation system

Oxidation and diffusion equipment

Ion implantation equipment

[Example]

The present invention is then explained by means of examples and preparation examples, but is not limited to them.

#### PREPARATION EXAMPLE 1

(Preparation of emulsion of fluorine-containing elastomer particles)

A 47-liter stainless steel autoclave having no ignition source was charged with 30 liter of pure water, 300 g of  $C_7F_{15}COONH_4$  as an emulsifying agent and 2.7 g of disodium phosphate·12H<sub>2</sub>O as a pH control agent. After the inside of a system was sufficiently replaced with nitrogen gas and deairing was carried out, the autoclave was heated to 50°C with stirring at 200 rpm, and a gas mixture of tetrafluoroethylene (TFE)/perfluoro(methyl vinyl ether) (PMVE) (TFE/PMVE=24/76 in mole ratio) was introduced so that the inside pressure became 1.18 MPa. Then 100 ml of an aqueous solution of ammonium persulfate (APS) having a concentration of 55.8 mg/ml was introduced with pressurized nitrogen gas to initiate a reaction.

With the advance of the polymerization, at the time when the inside pressure was lowered to 1.08 MPa, 62.3 g of di-iodine compound  $[I(CF_2)_4I]$  was introduced with pressurized nitrogen gas. Then 60 g of

TFE was introduced at its self-pressure and 60 g of PMVE was introduced with a plunger pump so that the inside pressure became 1.18 MPa. Thereafter with the advance of the reaction, pressurized TFE and PMVE were introduced similarly. Thus increasing and decreasing of the inside pressure were repeated between 1.08 MPa and 1.18 MPa, and at the time when a total amount of TFE and PMVE reached 6.5 kg, 7.8 kg, 9.1 kg and 10.4 kg, respectively, 25.6 g of an iodine compound  $\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CH}_2\text{I}$  was introduced with pressurized nitrogen gas. Every 12 hours after starting of the polymerization, 20 ml of an aqueous solution of APS having a concentration of 52.5 mg/ml was introduced with pressurized nitrogen gas.

When a total amount of the introduced TFE and PMVE reached 13 kg 33 hours after starting of the polymerization reaction, the autoclave was cooled and an un-reacted monomer was released to obtain an emulsion (A-1) of fluorine-containing elastomer particles (average particle size: 70 nm) having a solid concentration of 27.5 % by weight.

A part of the emulsion was sampled and nitric acid was added thereto for coagulation. The coagulated product was washed and dried to obtain elastomer powder. The Mooney viscosity  $\text{ML}_{1+10}$  (100°C) of the elastomer was 42, and according to  $^{19}\text{F}$ -NMR analysis, the components thereof was TFE/PMVE=62/38 (% by mole). The glass transition temperature  $T_g$  (center value) measured according to DSC was -3°C.

## PREPARATION EXAMPLE 2

(Preparation of emulsion of fluorine-containing resin fine particles)

A 6-liter stainless steel autoclave having no ignition source was charged with 3 liter of pure water, 30 g of  $\text{C}_3\text{F}_7\text{OCF}(\text{CF}_3)\text{CF}_2\text{OCF}(\text{CF}_3)\text{COONH}_4$  as an emulsifying agent and 0.27 g of disodium phosphate $\cdot 12\text{H}_2\text{O}$  as a pH control agent. After the inside of a system was sufficiently replaced with nitrogen gas and deairing was carried out, the autoclave was heated to  $80^\circ\text{C}$  with stirring at 600 rpm, and a gas mixture of tetrafluoroethylene (TFE)/perfluoro(methyl vinyl ether) (PMVE) (TFE/PMVE=88/12 in mole ratio) was introduced so that the inside pressure became 0.20 MPa. Then 4 ml of an aqueous solution of ammonium persulfate (APS) having a concentration of 2.5 mg/ml was introduced with pressurized nitrogen gas to initiate a reaction.

With the advance of the polymerization, at the time when the inside pressure was lowered to 0.15 MPa, a gas mixture of TFE/PMVE (TFE/PMVE=95/5 in mole ratio) was introduced with pressurized nitrogen gas so that the inside pressure became 0.20 MPa. Thereafter with the advance of the reaction, pressurized TFE and PMVE gas mixture (95/5 in mole ratio) was introduced similarly. Thus increasing and decreasing of the inside pressure were repeated between 0.15 MPa and 0.20 MPa.

When a total amount of the introduced TFE and PMVE reached 331 g 4.5 hours after starting of the polymerization reaction, the autoclave was cooled and an un-reacted monomer was released to obtain an emulsion (B-1) of fluorine-containing resin fine particles (average particle size: 44 nm) having a solid concentration of 9.7 % by weight. The average particle size was measured by mixing 120 mg of the emulsion and 4.4 g of dimethylsulfoxide and measuring with LPA-

3000, 3100 available from OTSUKA DENSHI KABUSHIKI KAISHA.

A part of the emulsion was sampled and nitric acid was added thereto for coagulation. The coagulated product was washed and dried to obtain a white fluorine-containing resin fine powder. The melt flow rate MFR of the fluorine-containing resin was un-measurable under conditions of maintaining at 372°C for five minutes. According to  $^{19}\text{F}$ -NMR analysis, the components thereof was TFE/PMVE=94.5/5.5 (% by mole). The melting point measured according to DSC was 290°C.

### PREPARATION EXAMPLE 3

(Preparation of emulsion of fluorine-containing resin fine particles)

A 6-liter stainless steel autoclave having no ignition source was charged with 3 liter of pure water, 30 g of  $\text{C}_3\text{F}_7\text{OCF}(\text{CF}_3)\text{CF}_2\text{OCF}(\text{CF}_3)\text{COONH}_4$  as an emulsifying agent and 0.27 g of disodium phosphate $\cdot 12\text{H}_2\text{O}$  as a pH control agent. After the inside of a system was sufficiently replaced with nitrogen gas and deairing was carried out, the autoclave was heated to 80°C with stirring at 600 rpm, and a gas mixture of tetrafluoroethylene (TFE)/perfluoro(methyl vinyl ether) (PMVE) (TFE/PMVE=88/12 in mole ratio) was introduced so that the inside pressure became 0.20 MPa. Then 4 ml of an aqueous solution of ammonium persulfate (APS) having a concentration of 2.5 mg/ml was introduced with pressurized nitrogen gas to initiate a reaction.

With the advance of the polymerization, at the time when the inside pressure was lowered to 0.15 MPa, 2.92 g of a di-iodine compound  $[\text{I}(\text{CF}_2)_4\text{I}]$  was introduced with pressurized nitrogen gas and then a gas mixture of TFE/PMVE (TFE/PMVE=95/5 in mole ratio) was introduced

with pressurized nitrogen gas so that the inside pressure became 0.20 MPa. Thereafter with the advance of the reaction, pressurized TFE/PMVE gas mixture (95/5 in mole ratio) was introduced similarly. Thus increasing and decreasing of the inside pressure were repeated between 0.15 MPa and 0.20 MPa.

When a total amount of the introduced TFE and PMVE reached 327 g 9.9 hours after starting of the polymerization reaction, the autoclave was cooled and an un-reacted monomer was released to obtain an emulsion (B-2) of fluorine-containing resin fine particles (average particle size: 44 nm) having a solid concentration of 9.4 % by weight.

A part of the emulsion was sampled and nitric acid was added thereto for coagulation. The coagulated product was washed and dried to obtain a white fluorine-containing resin fine powder. The melt flow rate MFR of the fluorine-containing resin was 21.1 g/10 min under conditions of maintaining at 372°C for five minutes. According to  $^{19}\text{F}$ -NMR analysis, the components thereof was TFE/PMVE=94.9/5.1 (% by mole). The melting point measured according to DSC was 280.7°C.

#### EXAMPLE 1

The emulsion (A-1) of the fluorine-containing elastomer particles prepared in Preparation Example 1 and the emulsion (B-1) of the fluorine-containing resin fine particles prepared in Preparation Example 2 were mixed in the amounts of 1,236 g and 619 g, respectively (solid content ratio: fluorine-containing elastomer/fluorine-containing resin = 85/15 in weight ratio), and the mixture was added dropwise over

10 minutes to 411 g of a 9 % aqueous solution of nitric acid being stirred and thus subjected to co-coagulation. The obtained co-coagulate was washed with water and dried to obtain an elastomer composition comprising the fluorine-containing resin fine particles finely dispersed in the fluorine-containing elastomer.

When the elastomer composition was subjected to DTA measurement, there was recognized at 272.6°C an absorption considered to be derived from the fluorine-containing resin. The composition was transparent.

#### EXAMPLE 2

Co-coagulation was carried out in the same manner as in Example 1 except that a mixing amount of the emulsion (B-1) of the fluorine-containing resin fine particles was changed to 412 g, to obtain an elastomer composition (solid content ratio: fluorine-containing elastomer/fluorine-containing resin = 90/10 in weight ratio). The composition was transparent.

#### EXAMPLE 3

Co-coagulation was carried out in the same manner as in Example 1 except that a mixing amount of the emulsion (B-1) of the fluorine-containing resin fine particles was changed to 206 g, to obtain an elastomer composition (solid content ratio: fluorine-containing elastomer/fluorine-containing resin = 95/5 in weight ratio). The composition was transparent.



#### EXAMPLE 4

Co-coagulation was carried out in the same manner as in Example 1 except that 638 g of the emulsion (B-2) of the fluorine-containing resin fine particles obtained in Preparation Example 3 was mixed instead of the emulsion (B-1) of the fluorine-containing resin fine particles, to obtain an elastomer composition (solid content ratio: fluorine-containing elastomer/fluorine-containing resin = 85/15 in weight ratio). The composition was transparent.

#### EXAMPLE 5

To 100 parts by weight of the elastomer composition prepared in Example 1 were mixed 1 part by weight of 2,5-dimethyl-2,5-di(t-butylperoxy)hexane as a crosslinking agent and 1 part by weight of triallyl isocyanurate as a crosslinking accelerator. The mixture was kneaded with an open roll to obtain a crosslinkable elastomer composition.

Vulcanizability of the crosslinkable elastomer composition was determined by a method described hereinbelow. The results are shown in Table 4.

Further the crosslinkable elastomer composition was subjected to press-crosslinking at 150°C for 30 minutes and then crosslinking in an oven at 180°C for four hours to obtain a crosslinked article. Physical properties in normal state of the crosslinked article were measured. Also an O-ring (P-24) was produced under the same crosslinking conditions and a compression set thereof was measured. The results are shown in Table 4.

(Vulcanizability)

A vulcanization curve of each composition for vulcanization is obtained at a temperature shown in Table 4 by using a JSR Curastometer Model II, and a minimum torque, maximum torque, induction time and optimum vulcanization time are obtained therefrom.  
(Physical properties in normal state)

100 % modulus, tensile strength, tensile elongation and hardness (JIS A hardness) in normal state (25°C) are measured according to JIS K6301.

(Compression set)

A compression set after allowing to stand at 200°C for 70 hours is measured according to JIS K6301.

#### EXAMPLES 6 to 9

A crosslinkable elastomer composition having components shown in Table 4 was prepared in the same manner as in Example 5 and vulcanizability thereof was determined. Also a crosslinked article was produced under the same crosslinking conditions as in Example 5, and physical properties in normal state and compression set were determined. The results are shown in Table 4.

A filler mixed in Examples 6 to 8 is a silicon oxide (AEROSIL 300 available from NIPPON AEROSIL KABUSHIKI KAISHA).

#### COMPARATIVE EXAMPLES 1 to 2

A crosslinkable elastomer composition was prepared in the same manner as in Example 5 except that fluorine-containing resin fine powder was not mixed. Vulcanizability of the composition was determined, and also a crosslinked article was produced under the same



crosslinking conditions as in Example 5, and physical properties in normal state and compression set were determined. The results are shown in Table 4.

### COMPARATIVE EXAMPLE 3

To the emulsion (A-1) of the fluorine-containing elastomer particles obtained in Preparation Example 1 was added a nitric acid for coagulation thereof, and the coagulate was washed and dried to obtain elastomer powder. On the other hand, to the emulsion (B-1) of the fluorine-containing resin fine particles obtained in Preparation Example 2 was added a nitric acid for coagulation thereof, and the coagulate was washed and dried to obtain a white fluorine-containing resin powder. To 85 parts by weight of the elastomer powder was dry-blended 15 parts by weight of the fluorine-containing resin powder to obtain a white opaque composition. A crosslinkable elastomer composition was prepared in the same manner as in Example 5 except that the above-mentioned composition was used, and vulcanizability thereof was determined. Also a crosslinked article was produced under the same crosslinking conditions as in Example 5, and physical properties in normal state and compression set were determined. The results are shown in Table 4.

TABLE 4

Elastomer composition	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Com. Ex. 1	Com. Ex. 2	Com. Ex. 3
Example 1	100	100						
Example 2		100						
Example 3			100					
Example 4				100				
Preparation Example 1 (elastomer powder)						100	100	85
Preparation Example 2 (fluorine- containing resin powder)								15
Crosslinking agent	1	1	1	1	1	1	1	1
Crosslinking accelerator	1	3	3	3	1	1	3	1
SiO <sub>2</sub>	-	3	3	3	-	-	3	-

- continued -

- continued -										
Vulcanizability (160°)										
Minimum torque (kg)	0.18	0.40	0.27	0.15	0.10	0.03	0.10	0.06		
Maximum torque (kg)	4.51	7.70	7.20	6.15	5.02	3.98	6.00	4.71		
Induction time (min)	0.7	0.5	0.5	0.5	0.6	0.5	0.6	0.5		
Optimum vulcanization time (min)	1.4	1.4	1.2	1.4	1.5	1.1	1.1	0.9		
Physical properties in normal state										
100 % modulus (MPa)	4.5	13.8	7.4	6.4	3.7	2.1	4.9	4.7		
Tensile strength (MPa)	20.8	24.9	22.8	16.3	18.3	12.3	16.5	8.6		
Elongation (%)	202	155	208	152	197	186	180	168		
Hardness (JIS A)	71	80	75	71	71	60	68	71		
Compression set (%)	33	27	22	12	34	18	13	37		

[Effect of the Invention]

The present invention can provide a composition capable of giving an elastomer molded article excellent in mechanical strength, abrasion resistance, transparency, etc.

[Document Name] ABSTRACT

[Abstract]

[Problem] There is provided a composition which comprises an elastomer and fluorine-containing resin fine particles finely dispersed uniformly in the elastomer and provides an elastomer molded article having excellent mechanical strength, abrasion resistance and transparency.

[Means to Solve] A composition which is obtained by co-coagulation of an emulsion of fluorine-containing resin fine particles having an average particle size of from 20 to 150 nm and an emulsion of elastomer particles and is used for obtaining a transparent elastomer molded article, in which the fluorine-containing resin fine particles are finely dispersed uniformly in the elastomer.

[Selected Figure] None